ENHANCING AGRICULTURAL EQUIPMENT AND MEDICAL DEVICES THROUGH BIG DATA ANALYTICS: OPTIMIZING PERFORMANCE, EFFICIENCY, AND DECISION-MAKING IN MODERN INDUSTRIES

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Abstract

There is very much information about big data in the case of business and others. The concept of big data has been known overall in recent years. Many sorts of data are obtained in agriculture, too. Equipment related sensor data is a long-established approach to fine-tuning the application of fertilizers and pesticides, by precisely monitoring crop response. The very nature of farming also makes it data-rich: GPS enabled vehicles and ploughs, tillers, harvesters and other implements churning out crucial geographic data, drones that scan the fields, and a multitude of other devices that can provide soil, weather and crop data. All these streams of numbers can now be aggregated, and whipped into place by sophisticated data-management and analytics software. This amounts to the building of platforms that will make data ultimately the basis on which the next wave of agricultural productivity will be driven. Treatethield Connexions, is known as one promising “big data” project for farming, which will by and large wallets the sheer amount of data generated by existing precision farming equipment, transfers it to an independent data platform, and analyses them to increase profitability for one better-informed, yet potentially marginalized community concerned. Many types of support are connected with this BD initiative to improve agriculture security. This includes the development of a wide range of farming equipment that will feed data into lay down events of connection, establishing better logistics for food distribution, reducing transportation costs for farmers and streamlining bulk exports. On the other side, it involves taking steps to improve market opportunities for farmers. Tradable titles of fungible goods will be introduced, and, in conditions likely to benefit large-scale farmers, many items relating to pesticide and fertilizer will be removed from the list of control.

Health Devices, Crop Yield Prediction, Real-Time Monitoring, big data, analytical platform, precision agriculture, soil management, machine health monitoring	

1. Introduction

Smart agriculture applications have been extensively studied in the last few years. The advances in making agricultural equipment more intelligent and capable of understanding the plant's needs and acting in real-time confronts a unique and challenging environment. A number of researchers used the wireless sensor for detecting environmental parameters in precision agriculture as an aeroponic system or agricultural vehicle. However, these techniques were regarded as high-specification consumer equipment. A little recent research presents the concept of adding smart agricultural machinery systems into simple agricultural equipment used by young farmers for agricultural operations. Big Data comes mostly from sensors, yield monitors, remote sensing, and interpolated weather information. Tapping into Big Data's potential will require open data, standards, interoperability, and discoverability. Agriculture is a fundamental and ancient practice that produces plants and livestock for human needs. Agriculture has become highly mechanized and IT-advanced in developed countries since the introduction of the first grain harvester in 1926.

Those advances have had a great impact on productivity and reduced the need for hard manual labor. However, agriculture remains inherently uncertain, complex, and difficult to control due to seasonal variation, weather-dependency, and unexpected fluctuation among other factors. Contemporary agriculture must address challenges in sustainability, food security, safety, and climate change. Advances in fields of real-time automotive technologies, robotics systems, communication technologies, and sensing networks have provided opportunities to manage and integrate physical systems into cyber systems. The fusion of cyber physical systems has enabled cyber agricultural methodologies, increasingly under the aegis of "Smart Agriculture." Such systems allow real-time perception, analysis, and actuation on the basis of large data sets. Generally, once raw data are gathered by sensors and systems, data pre-processing is performed as data input forces are sorter and cleaner organized, which data cleansing, data profiling, and data transformation methods are utilized. After that, preprocessed data are directed to the analysis phase, and depending on the objective, big data analysis is divided into a number of types including supervised learning, unsupervised learning, and optimization. On this step, the big data analysis tool is conducted by big data Hadoop, bigML, Apache Mahout, Clab, RapidMiner, Weka, etc.

Fig 1: Big data-based decision support system

1.1. background and Significance The increasing population leads to an increase in human life and needs. One of the basic needs in life is food and for this reason, everything must be done to increase productivity. The aim is to apply the big data concept to the data available in agriculture and medical devices and try to benefit from this data. Guidance for updating Agricultural Equipment, which is frequently used in agriculture, is to be provided as an output by increasing the efficiency of the data to be obtained. In agriculture, breeding for the purpose of increasing productivity is the main objective. Since the first coined, the concept has also seen the development of technology and diversification in this field. During this development process, the aim is to facilitate the work of the agriculturalist by taking the technical structure of the sectoral needs in seeking the net definitive questions such as the need to increase yields and efficiency. Since agricultural production is affected by the risks of nature, the objectives and technologies of the agriculturist are being targeted without taking the risks into consideration. Inevitably, complete control of nature is not possible, but precautionary measures will be initiated if the expected effect of the risks could be reduced. The use of applications to be developed in addition to the existing precision agriculture applications in order to increase agricultural resources has come to the fore with data mining, decision support systems and big data. With the applications developed, agricultural applications throughout the process from planting to harvesting have been made to save resources and obtain more products. One of these developed applications is the Guidance System (GS). After the invention of tracking systems, universities, research institutes and private sector organizations started work on this subject and made various inventions. In particular, after the invention of the GPS, there was progress in this field, commercial and non-commercial GPS receivers took place on the market and it has been started to be used in agricultural fields. At the moment, after the development of the satellite system, which is used in the world, it has been started to be used in many areas and data met from a few meters.

Equ 1: Optimizing Performance and Efficiency in Agricultural Equipment

$$F_e = \frac{P}{L \cdot t}$$

Where:

- P is the power output of the engine in watts.
- L is the load on the engine (measured in kg or N).
- t is the operating time in hours.

2. Overview of Big Data Analytics

Globalization has altered the agricultural sector significantly in recent decades. While optimizing products, making them cost efficient, and linking them to various services and standards throughout the whole value-chain remain fundamental targets of an agricultural production system, new features have been incorporated in the process. Within this scope, the digitalization of products and services via communication and sensory technologies is one of the ongoing means to enhance effectiveness, safety, and user satisfaction in agriculture as well as in other sectors. Moreover, the Internet of Things (IoT) and Industry 4.0 paradigms further promote this trend, where equipment and systems are equipped with integrated sensors, transmitters, and effectors, which in turn are linked to cloud storage structures for administrative and analytical purposes.

Historical, or other more traditional agricultural production systems were operated mostly mechanically with human farm labor, utilizing large-sized equipment. While their use is still widespread in developing or underdeveloped countries, they are gradually being replaced by more efficient and effective automated, semi-automated or robotic systems where such technological advancements are accessible. In the meantime, even in the most developed countries, small-sized equipment or implements are still in use on small or awkwardly shaped fields, or for specific treatments where automation or robotics is not economically viable. Inspired by this observation, a novel cost-efficient data acquisition system suitable for retrofitting on small machines, but also for second use on other types of tractor-driven equipment, has been developed based on low-resolution inertial measurement and ultrasonic distance sensors on a 3-point linkage frame. Tractor and implement-mounted sensors are typically employed in contemporary agricultural machinery, but they require modifications for each new implement on older tractors. By aiming to eliminate these limitations, the proposed system includes a universal, magnetically mounted, simple-to-use, Bluetooth-enabled, ultrachastically powered dumb-module, measuring mowing/transmission angle, lifting height, and lift arm hydraulic loads. Gratuitously streaming inertial and ultrasonic proximity data and acting as a dongle, it can be connected to a tab, smart-phone, or a special receiver, offering an informative user interface. The generality of the acquired data has been indicated via a limited number of use cases in grasslands, where data acquisition could be performed and analyzed without the designed system. However, future development of complex, low-cost, highly integrated SMD Bluetooth modules may further address these limitations.

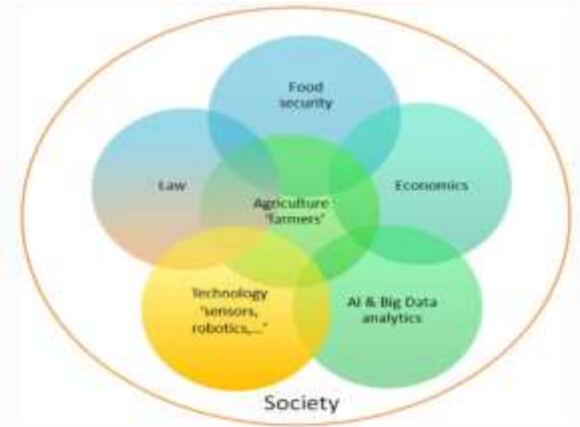

Fig 2: Data analytics for crop management

2.1. Definition and Importance People in the world are producing far more data now than has been produced in their entire history combined just a few short years ago. Picture a stack of 40,000 CD-ROMs reaching from the Earth to the moon. That's approximately 15x1021 bytes of information, and it has been estimated that about that much new data was generated in 2006. Granted, this number is a bit dated at this point and advances in information technology might have changed the order of magnitude somewhat since then, but it still goes without saying that big data—very, very big data—is now a commonplace. At the same time, technology is continually advancing, giving society the ability to process and analyze these vast quantities of information, possibly unveiling important and sought-after answers. In recent years, the relevancy of big data analytics has rapidly expanded across a wide array of fields, and research has increasingly hinged upon its potential to address a plethora of questions. In the domain of plant production, in particular, there has been a burgeoning interest in harnessing big data analytics in order to monitor, model, and manage the growth of crops. In this review, an attempt is made to describe big data with respect to its varying perspectives and to outline its applications in farming with an emphasis on how it might influence the future of crop cultivation.

2.2. Key Technologies in Big Data Big Data Overview and Medical Devices There is a massive shift towards digitalization over every sector, and data are accumulated regularly as a result. The created data needs to be settled even in storage. Data could change into information and that knowledge can direct the improvement of various domains. Currently, data storage, management, and analysis are getting to be sophisticated, because data are not only structured and unstructured, but also significant in number. The affiliated dataset is extending towards terabytes (TB), zettabytes (ZB), petabytes (PB), and exabytes (EB). This vast size dataset is referred to as Big Data. It is notable that large information aggregation is not acceptable via ERP, ordinary database systems, and/or storage. In research and practical fields, many efforts have been made to settle this situation, and terminologies like data mining, KDD (Knowledge Discovery in Databases), big (massive) data, data retrieves have become more common. Big Data has been a notable trend in various domains. Big Data is one of a few efforts that can potentially render market differentiation among companies. This massive aggregation emerges due to its extensive contributions. The most common definition of Big Data involves the volume, velocity, and variety of information. Large information has a huge amount of information which usually exceeds 1 Terabyte (TB). A majority of large datasets across various domains have reached the size of zettabytes (1021), or even yottabytes (1024). This is beyond the conventional storage capability of any database and super computational strategies. Big Data's powerful apple has grown to 2.5 billion bytes each day? Thus, the volume of Big Data is proliferating significantly at numerous domains. Along with its magnitude, the speed of Data is another concern in Big Data. Streaming information in high velocity, such as those from internet clicks, communication information, or real-time sensors, ultimately has the potential to lose significant intelligence if not addressed promptly. Velocity refers to the rapidity of information generation. Variety can occur in a more wide arrangement, without being classified accurately. This can be in the format of texts, images, weblogs, demographics, videos, and others. Big Data is called Variables and unstructured information in some papers. Additionally to the above 3Vs, Big Data also shows the inside of intelligence and reliability of datasets. Uncertainty is common in noisy, inaccurate and inconsistent information from facts. Quality and Trusted sources become a big problem for analysis. Traditional RDBMSs have difficulty in managing this kind of large data sets. Furthermore, Big Data introduces cloud technology, it has different presentations and it is not easy to generate instruments or applications to manage data from various sources. Apache Hadoop framework is used to supply an efficient medium, and its compatible techniques allow for prolonged large scale data analytics in a distributed context. Although big data offers an improving approach, there are also potential threats to its implementation, such as data confidentiality, redundant databases, integrity, reliability, and uncertainty. To maintain control of these risks, a well-defined privacy policy is highly requested and solid covert technology implemented to keep away from information loss.

3. Agricultural Equipment Optimization

The last 20 years have seen technological advances and the introduction of agricultural technology and information systems within agriculture. Precision farming represents the collection of site-specific information based on crop health and yields, field topography, weather, soil samples, and even contamination resulting from animal husbandry. It allows the optimization of management of crops and soil by increasing crop yields, quality and profitability and by reducing the environmental damage. Precision agriculture relies on accurate information acquisition, such as the development of sensors for data collection, the usage of global information systems for system control, and the exchange of data based on documented standards. The adoption of current precision agriculture methodology is still modest and by far not broadly disseminated to the rapidly growing majority of small and mid-sized farms operated by inexperienced individuals in agriculture. The development of smart technologies can increase the use and effectiveness of precision agriculture for the vast majority of farmers by providing a user-friendly tool for prompt response. In order to increase the use of precision agriculture technology, the use of simple innovative systems that detect farm property and are capable of responding automatically can be used. In college, students can get involved in the building automation system in order to create a healthy environment by monitoring and controlling the parameters. After analyzing the literature, a model was proposed for the improvement of the centralized air conditioning system. Considering the proposed architecture and the limitations, the system was appropriately designed. The students from electrical and mechanical engineering can implement the concepts in the actual world and enhance the learning capabilities for the betterment. Smart devices like smartphones and tablets were used with Android applications to turn ON and OFF and control the temperature. Were able to monitor the real time temperature, humidity and control the speed and temperature using the Android application, because the building cooling and heating calibration according to outside parameters without manually touching. Several sensors were connected through microcontrollers then sensor interfaced microcontroller data sent to the web server and stored into the database for future use and the data accessed from any internet server and processing. Developing software applications both on the web like Java using Netbeans IDE and Android applications through the Android studio.

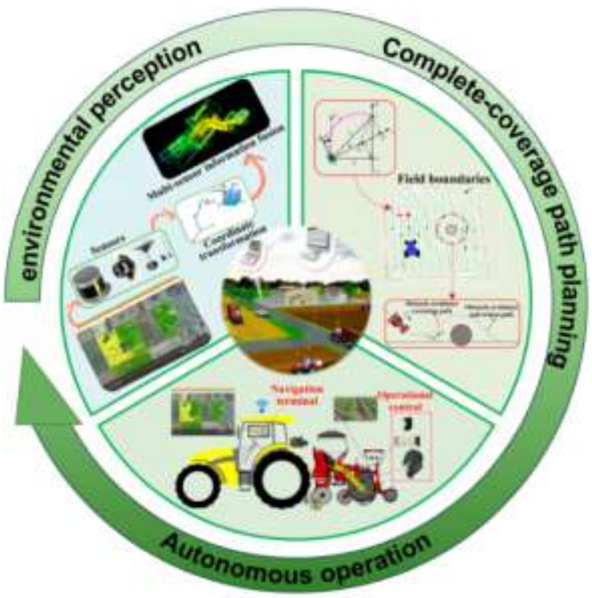

Fig 3: Agricultural Equipment in Large Fields

3.1. Current Challenges in Agriculture Modern agriculture faces the formidable challenge of meeting increased demands for food, fuel, feed, and fiber with a population expected to surpass 9 billion by 2050. All this will have to be accomplished under the constraints of climate change and dwindling natural resources. Currently, innovative solutions are needed to help improve the productivity, sustainability, and resilience of agroecosystems. As various sensors and Internet of Things (IoT) instrumentation become more available, it becomes possible to conduct data collection, integration, and analysis in real-time. The data generated by the sensor network is usually collectively referred to as Big Data. The amount of generated data can pose a challenge to storage and analysis. Tremendous amounts of data can be generated from the sensor network and the data are also generated from GPS, phenotyping platform, and laboratory analyses. When all of these data are combined and integrated together, total data generation and storage largely exceeds what a local machine can handle. Current practices of downloading data and importing them into spreadsheet or statistics packages for analysis have become increasingly inefficient and fail to fully utilize the data. This is particularly important as the research is shifting toward a more interdisciplinary approach and thus the data are generated from different disciplines which are also highly heterogeneous. Hence there is a critical need to design a new data management infrastructure that implements the principles of Findable, Accessible, Interoperable, and Reusable (FAIR). Here we propose Agriculture Data Management and Analytics (ADMA) that satisfies the FAIR principles. ADMA is a cloud based data management and analysis platform that is currently being developed to handle data generated in an interdisciplinary, large-scale agriculture smart farm research endeavor. As part of the Advances in Data Sciences Symposium, here we discuss methodologies, tools, and approaches developed to address the unique challenges of handling agricultural Big Data. This includes an overview of standards and protocols that collect data in structured format and transmit them through Application Programming Interfaces to a server. All the data collected are stored in a cloud based infrastructure called ADMA. In the cloud, data is cleaned and preprocessed using edge and cloud computing infrastructure and represented in a common format. Integration with High Performance Computing capacity in the cloud enables running advanced data analysis and machine learning tools. This iteration can be a feedback loop where results of the data analysis can be returned to the farmer or pre-processing facility through an HTTP API and "Field Boundary" file as an output.

3.2. Role of Big Data in Precision Agriculture The era of big data is here. The combination of big data and machine learning technology can make the current medical devices smart and capable of providing proper treatments and prescriptions. A health monitoring system includes three sensor modules: an accelerometer, an ECG module and a temperature sensor. With a smartphone or smartwatch collecting the sensor data and transmitting it to a server, the doctor will be able to review the patient's status and to understand the patient's daily activity, suffering, and sleep quality. Several companies have announced and sell smart detection equipment that can be used at home which is worked by an AI server. The user just needs to put biological information, such as face pictures, blood, urine and saliva, into this equipment and the AI server will analyze the data and return medical advice. This intelligent medical system can change and expand the medical field and improve the service to a larger population, including people in remote areas. On the other hand, the smart condition monitoring system has its advantages over the smartphone or the smartwatch wear device monitoring. For military applications, the daily exercise of soldiers is so intense that medical devices may have a short life in actual usage. However, a smartwatch or smartphone that can transmit the sensor data to a server can be used for a longer time. Comfortable wear devices are designed to track daily activities. This system includes a gyroscope, accelerometer, ECG and temperature sensor. Every sensor module can be charged wirelessly and all of the modules assembled onto a two-layer PCB. The PCB is encapsulated by a soft heart and placed in a 3D printed box. This kind of design not only makes the system compact and lightweight, but also comfortable to wear. The physiological signal and daily activity function have been validated. The system is connected via Bluetooth to a smart device and has a connection to server function. A user's smartphone or smart watch can collect personal data from the sensor modules and transfer the information to the server. The doctor checks the phone or server and can infer a patient's status to understand daily activity, suffering, and sleep quality. By considering the development of the smart condition monitoring system, there are two research projects aimed to explore.

Equ 2: Uptime Optimization Using Predictive Maintenance

$$P(\text{Failure}) = \frac{e^{-r \cdot t}}{1 + e^{-r \cdot (t_0 - t)}}$$

Where:

- $P(\text{Failure})$ is the probability of failure at time t.
- r is the failure rate constant.
- t_0 is the expected lifetime of the equipment component.
- t is the time at which analysis is performed.

4. Medical Devices Enhancement

In the era of the era 4.0 industrial revolution, a comprehensive strategic maintenance management system for 13,352 units of medical equipment utilised in public health clinic facilities was developed. This strategic maintenance management system consists of 2 main stages, namely, the prioritisation assessment and predictive maintenance management. The prioritisation assessment system is designed to identify the eligible medical equipment for maintenance management in the first phase. Then, the predictive maintenance management system is developed to determine the next eligible maintenance method for the medical equipment in the second phase.

In developing a medical equipment prioritisation assessment system and robust predictive maintenance management system, 13,352 medical equipment dataset samples were extracted. The medical equipment dataset was obtained from 2015 to 2020 from 19 categories of medical equipment located at 131 public health clinic facilities in 10 states in Malaysia. A total of 16 medical equipment features were used as the inputs of the prioritisation assessment system in the first stage. The identification of these features was based on thematic analysis. A diagram of the thematic analysis adaptation and thematic analysis of the medical equipment features input assessment systems prioritisation is illustrated.

Moreover, on Big Data healthcare, the scientific study by developing the Big Data predictive model for a sensor-based medical device, the smart body analyzer. The weight measurement information was uploaded to a smartphone app several times. The transmission flow caused the result of numerous data. The convergence of the understanding of Medicine 4.0 and the growing emergence of Big Data has paved the way for the subsequent exploration of the needs of medical devices. Emphasis is placed on smart healthcare medical devices from an IoT sensor-based health monitoring app. The next part related to the management of IoT sensor-based equipment and software devices considering real-time health monitoring apps focuses on strengthening the accuracy of the measured data. It's a new approach to various errors and non-measurable factors on Big Data. Additionally, the importance of the pre-processing phase is shown in accelerating the management enhancement of the Big Data sensor-based medical device. It is suggested that the enhancement of equipment management awareness in medical devices will be directed to gear up to keep abreast of progressive Big Data health technology.

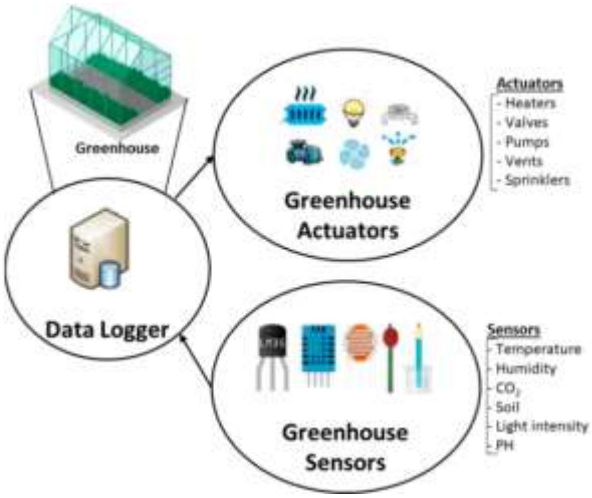

Fig 4: Medical Devices Enhancement

4.1. Challenges in Medical Device Performance Challenges in Medical Device Performance Amid Healthcare Services Based on Scalability, Reliability, and QA During the global COVID-19 pandemic, medical devices are identified as a critical asset due to patient care necessities. In healthcare services, medical devices are used to sustain clinical activities by diagnosing, observing, and managing various diseases and treatments. The application of medical devices cannot be separated from high performance expectations. However, problems related to medical devices can occur, such as being slow or not running, so problems occur in making various medical diagnoses and actions which depend on medical devices, so the performance of medical devices becomes an important requirement in healthcare services. Medical devices must protect patients and operators against undue risk. The reliability of medical devices must be primarily contained in critical devices such as ventilators, defibrillators, infusion pumps, syringe pumps, etc. This situation does not yet guarantee critical medical devices or individual intensive care unit medical devices are safe, reliable, and will protect patient safety over usage time.

4.2. Big Data Applications in Healthcare Catching the insights of health-related features and improving healthcare services using such insights from big data processed over various resources are known as Health Big Data Analytics (HBDA). Possible health-related features may be any clinical tests, medical devices, daily routine data, fitness tracker and medical images data. Today, various wearable devices have been developed which are used for monitoring vital health related features continuously. Besides these, various medical devices provide health related features derived from respective tests done at home by patients. However, these health related features either from wearable devices or medical devices, when processed over Big Data analytics, may provide various insights of health-related features. Such insights of health-related features from big data may be useful for prevention of life threatening diseases. Loses which are irreversible using health resources, improvement in medical devices and scheduling the demands of such health resources. While the possibility of developing these features in developing/underdeveloped countries or low population density areas exists as they lack well-organised healthcare service. However, the demand using the same small-scale farming cannot be manually sustainable. That is where modern technology using more efficient productivity comes. In growing business activities such modern technology significantly becomes more diversified and resultantly agribusiness entrepreneurship becoming more popular including smallholder farming. A recent trend, within technology advanced urban society, is that people in developing/underdeveloped countries are seen to be more interested in farming for their own health, environment friendly purpose, and to fight against hunger. Hence they opt for family farming where a very small piece of land is enough for them. On the other hand, the health disease monitoring industry is increasing where a rapid, and efficient health facility is the most important adjunct to improve healthcare service. Our detailed experimental analysis provides big data analytics over health related features from medical devices, recently proposed to present how big data over health-related resources can enhance it using several insights technology, advanced academic analytics, and empowering doctor-medicine and diploma, or family science in the agribusiness, medical and technology sectors, also supporting the socio-economic policy guidelines among the young.

5. Data Collection Methods

Tackling grand challenges humanity is facing needs bright minds, new knowledge, and continuous innovation. And it is increasingly clear that humankind’s greatest challenges will be faced by those living in cities which may account for 75% of the world population by 2050, with 6.3% being 65 years or older. Managing food supply chains with complete and safe products under limited water resources is another challenge, while improving farm income is still a grand challenge for the developing world. Over and above the implementation of demand-driven policies, young farmers face a number of challenges in adopting new technologies. ‘Big data’ initially referred to ‘large volumes of data’, but the notion has evolved to information gathering, integration, and analysis that enables the visualization of trends, patterns, and anomalies through different stages of data processing. Tools for processing big data have been found in the agricultural sector to investigate and to improve efficiency and to better protect the production process.

Now, targeted agriculture extension programs and innovations to help the young are in demand, as knowledge extension currently leaves young farmers behind. When a system registers limits along a large set of options for assessing and managing the future, it can be called big data. Moreover, a system within financial markets can also be connected to refer to the complex-structured data, both static and dynamic, resulting from the extraordinary rates of trading details. Working polemically, referred to big data systems as data-mining observations supporting the transformation of predictions and to reach future-minded decisions. Positive and negative context of the systems has recently been acclaimed. Efforts are driven by the needs of industrialized and developing market economies through observation of the circumstances of adopting and using big-data collecting devices by young farmers. To contribute to this challenge, efforts to optimize the big data acquisition of the monitoring functions protecting the visual resources—the basic working tools for information gathering—were adapted. The quickly developing remote sensing technology-based functions observed in action are discussed, including applications and levels of observed investment.

5.1. Sensors and IoT in Agriculture Sensors play an important role in improving agricultural productivity. In order to support sustainable agriculture, monitoring the status of crops, soil, and water in many agricultural fields should be integrated into decision making processes. Soil sensor technology combined with the Internet of Things is increasingly becoming the standard within the agricultural sector. Soil data retrieved from soil sensors allows for more intelligent recommendations on crop planting and land management. Currently, IoT technologies have been developed and can be integrated with networked soil sensors to collect and manage soil data in the cloud. It is crucial for the agricultural extension to develop a simple mobile application that can provide user-friendly suggestions on cultivation methods by considering soil conditions. Agricultural productivity depends on multiple parameters: those of soil, weather, crop and other farm management practices. In recent years, the usage of Internet of Things and Wireless Sensor Networks for agriculture has drawn much attention worldwide, which has resulted in a number of studies encompassing multiple projects and challenges. There has been a substantial upgrowth in the deployment of sensors in agriculture to satisfy the growing commitment in this field and urge the advancement of multidisciplinary studies. Agriculture is known to be the largest employment sector in most countries. In most developing countries, and Ethiopia is no exception, there are smallholder farmers whose livelihood depends primarily on agriculture.

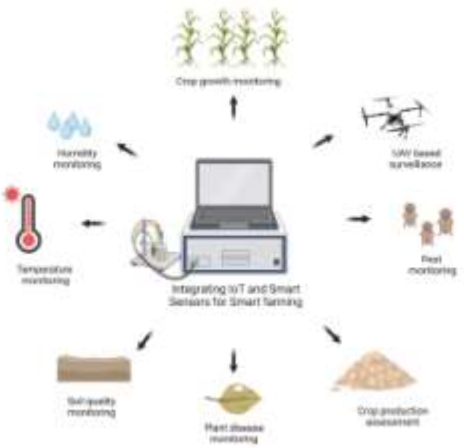

Fig 5: Smart sensors in agriculture

5.2. Wearable Technology in Healthcare The widespread availability of real-world data and computational power, combined with recent advances in big data analytics, have presented new opportunities in various application domains. Many recent research activities have illustrated the substantial impact of big data analytics on enhancing agricultural equipment and medical devices. The general mechanisms, methodologies, and service sectors are reviewed to provide more thorough insight into the potential impacts and applications.

The agriculture sector is the most vulnerable to and deeply influenced by global climate change. Big data analytics have been widely applied to the agricultural industry to provide advanced technologies for the monitoring, assessment, prediction, and handling of impacts related to climate change. The general mechanisms of big data analytics in enhancing agricultural equipment consist of the data collection system of agricultural equipment, data generation and accessibility, data transmission, data storage, data fusion engineering, big data engineering, serialization and industrialization, data sharing technology, data security, and data accuracy.

The healthcare industry has significantly advanced and shifts from traditional treatment-focused healthcare investments to personalized medicine with a patient-centric focus. It is projected that big data analytics can further greatly influence the transformation of healthcare and manufacturing. It could provide more understanding for the healthcare industry and make more distinctive contributions to the management of the medical devices. The general mechanisms of big data analytics in enhancing medical devices consist of the data-driven mechanism of medical equipment, data collection and archive, analysis of adverse event data, superiority analysis, data verification process, legal affairs and compliance mechanism, and literature evidence system.

Equ 3: Accuracy of Diagnostic Devices (Machine Learning Model)

$$A = \frac{T_p}{T_p + F_n}$$

Where:

- T_p is the true positive rate (correct diagnosis).
- F_n is the false negative rate (incorrect diagnosis).

6. Data Analysis Techniques

This paper examines a variety of data analysis techniques, including graphical, statistical, artificial intelligence, and machine learning methods. Additionally, a brief stratify of the current state of knowledge concerning big data in the agricultural and medical device industries is conducted on the measurement and data warehousing tools needed to bring big data analysis to agricultural machinery, such as developments already being done for tractors.

In recent years, precision agriculture that uses modern information and communication technologies is becoming very popular. Raw and semi-processed agricultural data are usually collected through various sources. Agricultural datasets are very large, complex, unstructured, heterogeneous, non-standardized, and inconsistent. Agricultural data mining is considered a Big Data application in terms of volume, variety, velocity and veracity. It is a key foundation to establishing a crop intelligence platform, which will enable resource efficient agronomy decision making and recommendations. A continental level agricultural data warehouse by combining various technologies.

Big Data concepts and technologies are explained, followed by a review of their applications related to Electrical and Information Technologies for Sustainable Agricultural Management. In precision viticulture, like in many other big data agriculture applications, there is a variety and large quantity of input data for decision-making. Precision viticulture uses data analysis and machine learning on big data to find patterns, create models, and suggest decisions.

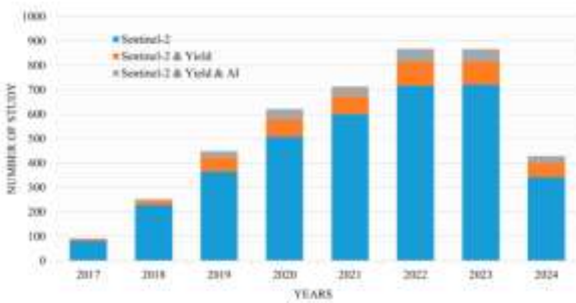

Fig : Crop Yield Estimation

6.1. Machine Learning Applications The field of Agriculture is one of the oldest and most established sectors of human civilization. It is the art, science, and business of cultivating the soil, producing crops, and raising livestock; and by extension, the industry that ensures a country produces enough food. As such, the technology that has been applied and developed in this field has evolved over thousands of years, from the simplest hand tools through simple machinery to the highly sophisticated electronically controlled tools of today. The ultimate aim of all these efforts is to improve the efficiency by which nutrients are supplied to produce, whether that produce be crops or animals.

Agricultural Equipment is a great driver of interest about Engineering practices. The Human effort required to produce food from the land undoubtedly declined significantly. This has alleviated the need for more than 70% of the working population to be employed in agricultural activities, as was the case before the arrival of mechanization. Despite this reduction in labor effort, the yield of food produced has greatly increased. Modern combining harvesters can process in one day the crop that would have taken weeks to process by hand. A modern tractor and plow can prepare thousands of hectares in the time it would have taken teams of horses months to achieve. However, currently the equipment used in the food production system is now agriculturally very demanding to operate and use.

6.2. Predictive Analytics in Agriculture Real-time agricultural analytics is much more complicated than other applications of big data. Many data sources exist that are not in a digital form (for example, the weather) [7]. Millions of farmers throughout the world are not connected to the internet. Farms are much more widely dispersed than cities and so will be harder to hook-up to the computational cloud, their tractors are not as reliable as computers, and they are broken most of the time. As almost everything we do is reliant on agriculture, if we are to have a data-led approach to anything at all we have to overcome these challenges. The success of Irish agriculture depends upon it. Despite this, there are several isolated aspects of farming that are becoming data-led, such as predictive harvesting in the states. But, these are a drop in the ocean compared to the range and scale of the problem. On 1 May 2015 a tractor accident in Poland involving a 46 cubic meter manure tank killed 64 people.

7. Conclusion

The aim of this paper is to design a big data acquisition method from smart agricultural machinery systems based on major equipment, referred to as intelligent tractor and combine, and new technology of their implement for young farmers. Big data is a field that treats ways to analyze, systematically extract information from, or deal with data sets that are too large or complex to be dealt with by traditional data-processing knowledge.

The basic principles and procedures of designing a data warehouse to extract useful hidden information from input datasets are presented. We focused on how to make big data, which obtains from major agriculture machinery of intelligent tractor and combine, more easily understood by young farmers. These are discussed as follows; (1) The techniques leading customers to big data business, (2) How to promote big data usage, (3) Research and development of smart agriculture machinery, and (4) Special consideration on big data design for young farmers. And, a successful business case is shown as proof of the positive effect of adopting smart agricultural machinery systems (SAMS).

In recent years, precision agriculture that uses modern information and communication technologies is becoming very popular. Raw and semi-processed agricultural data are usually collected through various sources, such as the Internet of Things (IoT), sensors, satellites, weather stations, robots, farm equipment, farmers, and agribusinesses. It is necessary to process them well to transform them into valuable knowledge. Hence, agricultural data mining is considered a Big Data application. It is a key foundation to establishing a crop intelligence platform, which will enable resource efficient agronomy decision making and recommendations. In this paper, a continental level agricultural data warehouse is designed and implemented by combining Hive, MongoDB and Cassandra, which can analyze data collected from various sources, and can provide analytical results, such as weather, NDVI, crop accumulations, and market prices, to the managers, researchers and farmers. This system can run on a single computer or small server farms.

7.1. Future Trends The last 20 years have seen an increase in technology and information systems in agriculture with the aim to increase yield, reduce costs, as well as the environmental footprint of the production. However, there are recognized significant challenges in creating and delivering step changes in the precision agri-food sector. The objective of this research is to present work in progress about a project to make big data from agri-machinery systems usable for young farmers as an actionable intervention, thereby providing a bigger and better connected view of farm and field data. The aim is to generate solutions to common challenges faced by young farmers, amongst whom there is a much lower rate of adoption of precision agri-technology. For this research, the presentation is focused on the big data needs of growers and the development of an accessible big data system for farm management. Additionally, the aims are to stimulate discussion and the sharing of knowledge about possible ways to achieve this. The presentation includes highlights from literature reviews, a series of interviews about the big data needs of growers and early results of a participatory action research project to make big data from smart agricultural machinery systems easily usable for growers. For interventions to be effective, they must identify possibilities of change that are within farmers' power to implement, they must be actionable and based on good evidence. Analysis of interviews with 23 growers from West and South Western France has highlighted patterns of difficulties faced by young farmers, for example the impact on decision making of not having access to data outside the cab which one is working or the difficulty of making sense of the data produced by many and various proprietary systems. With the development of the Internet of Things, of robots and of small sensors, agriculture has a significant potential to enhance its system management capacity based on rapid data collection and analysis.

At the farm level, big data will enable capitalizing and analyzing the flood of data expected to arise from the multiplication of smart machinery systems and from interconnected stations. As agriculture robots and new sensors are beginning to emerge on farms and as the quantity of data collected by connected machines grows, farming processes will become increasingly influenced and guided by data. The big data that's going to be used in crop-production results from heterogeneous sources: satellites, sensors on farm equipment, yield monitors, sensors in fields to measure soil properties, remotely piloted drone/UAV to do aerial analysis, and weather stations to measure weather variables. To make big data usable and relevant, beyond the technological development and advances in data sciences, requires open data, voluntary standards, interoperability protocols and devoted tools for data indexing and discoveries. In addition, to unleash new services and business models, cloud computing and knowledge-based platforms are necessary to dynamically connect tightening machines, provide data storage, backup and processing, connect them to complementary databases and enable external data access. By 2024, such digital agriculture is anticipated to be developed and widely adopted, while the challenges are to ensure knowledge, data, and technology transfer to the myriad of labs and start-ups all over the world. This presentation was set to generate ideas and to encourage the sharing of available resources related to data processing and big data from machinery and equipment. At the farm level, big data will allow capitalizing and analyzing the data collected by the connected machines. The data-driven farming system will rely on solid infrastructures to combine, share, and store the data from different sources. However, at the moment, the existing data generated by the connected machines is much richer, but this diversity in sources and formats makes it difficult to be exploited in a broad and easy way. The "digital divide" between farms will be the major issue, and it is crucial to set up the global and EU-level regulations on data standardization, interoperability, sharing, access, and privacy while ensuring the usability and flexibility of developed standards. To be usable and relevant, the necessary tools for data processing and visualizing will be always validated, improved, and open.

8. References

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